Physics 230

Homework Set 9

1. A spaceship passes earth traveling at a speed of $V = (5/13)c$ and is heading for a distant planet 25.0 c·years away. Both the earth and the distant planet are at rest relative to one another and their clocks have been previously synchronized, both reading zero when the spaceship passes earth. Just as the spaceship passes earth, the spaceship observer sets his clock to also read zero and explodes a flashbulb at that point. Later, the flash is seen by an observer at rest on the distant planet.
   a) What does the distant planet clock read when the distant planet observer sees the flash?
   b) When the distant planet observer sees the flash, where is distant planet located according to the spaceship's coordinate system?
   c) For an observer at rest in the spaceship frame who is at the location of coordinate found in part b) when the flash is received by the distant planet observer, what does their clock read?

2. Spaceship A moves to the right at a speed of $V = (4/5)c$ relative to spaceship B. Both spaceships have synchronized their own clocks in their own reference frame. Just as the origins of their respective coordinate systems pass one another, clocks at the origins of both frames read zero and a flashbulb explodes at that point. Later, the flash is seen by an observer in the spaceship A frame 150. meters to the right of the spaceship A origin. This problem should be analyzed from the perspective of the spaceship B observers.
   a) What does the observer's clock read when the observer detects the flash?
   b) When this observer sees the flash, where is the observer located according to the spaceship B observers?
   c) According to the spaceship B observers, what do their clocks read when the spaceship A observer sees the flash?

3. Two spaceships A and B are moving in opposite directions, each measures the speed of the other to be $(4/5)c$. Relative to our frame of reference, spaceship A moves to the right and spaceship B moves to the left. Each spaceship contains two clocks with one at the nose and one at the tail, synchronized with one another in each ship's frame. Spaceships A and B have nose and tail clocks N_A, N_B and T_A, T_B, respectively, and the origin of each coordinate system is placed at the location of their nose clocks. The rest length of spaceship A is 150. m and the rest length of spaceship B is 450. m. Just as the nose of B reaches the nose of A, both ships set their nose clocks to read zero as a flashbulb explodes at their origin. Later the flash is received by T_B.
   a) What time does T_B read when clock T_B receives the flash?
   b) When T_B receives the flash, where is clock T_B located according to spaceship A's coordinate system?
   c) For an observer in spaceship A's frame who is located besides T_B when T_B receives the signal, what does their clock read?

4. Spaceship A of rest length 150. m moving at a speed $V = (4/5)c$ relative to us contains a passenger in the ship's tail. The passenger fires a bullet toward the nose of the ship, at speed $(3/5)c$ relative to the *spaceship*.
   a) How fast is the bullet traveling relative to us?
   b) How long is the ship in (i) our frame, (ii) the ship's frame, (iii) the bullet's frame?
   c) How much time does it take the bullet to reach the nose of the ship, as measured by (i) passengers in the ship, (ii) us?

5. Spaceship A of rest length 150. m moving at a speed $V = (4/5)c$ relative to us contains a passenger in the ship's nose. The passenger fires a bullet toward the tail of the ship, at speed $(3/5)c$ relative to *us*.
   a) How fast is the bullet traveling relative to the spaceship?
   b) How long is the ship in the bullet's frame?
   c) How much time does it take the bullet to reach the nose of the ship, as measured by (i) passengers in the ship, (ii) us?